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### A CONTRIBUTION TO THE LICHEN FLORA OF ARIZONA AND NEW MEXICO

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The lichen flora of the states of Arizona and New Mexico is much less known than that of many other sections of the United States. In addition to the references on distribution given in the standard works of Tuckerman (1882, 1888) and Fink (1935), there are only scattered papers in the literature which are concerned with the lichens of these states. Tuckerman, in 1860 and 1862, reported on the collections made by Fendler near Santa Fe. When these records were brought together in 1866, several collections made by Wright in New Mexico were added. Tuckerman (1878) also wrote up some Arizona collections made by the U. S. Geological Survey of the 100th Meridian. It was not until some time later that Fink (1909, 1909a) studied the lichens of the vicinity of Tucson, Arizona, from where some new species were described by Zahlbruckner (1908, '09). In 1932 Bouly de Lesdain published an account of lichen collections from the vicinity of Las Vegas, New Mexico, made by Brother Arsène Brouard, and, in 1942, on further collections from the vicinity of Santa Fe. Magnusson (1929, 1937) treated the *Acarospora* of Brother Arsène Brouard. Herre (1944, 1950) has provided additional information on the lichen flora of New Mexico from San Miguel and Sierra counties. Finally, Darrow (1950) has reported on the arboreal lichen flora of southeastern Arizona. The present paper includes forms from some new localities in Arizona and New Mexico of which three are new species and a number are additions to the flora.

This compilation is the result of a study of two collections: (1) that of Dr. Robert A. Darrow made in various localities in southeastern Arizona in 1933 and 1934, and in the 1940's which includes only saxicolous and terricolous forms; (2) that made by Mr. and Mrs. Francis Elmore at Chaco Canyon National Monument in northwestern New Mexico in 1952. The latter is for the most part saxicolous, but a few corticolous forms are included. Thus most of these lichens are crustaceous rock-inhabiting ones which form a conspicuous element in the vegetation of these arid mountainous regions.

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\* Missouri Botanical Garden.

The arrangement and nomenclature, wherever possible, follows that of Fink (1935). The treatment of *Acarospora* is in accord with that of Magnusson (1929a). A complete set of specimens is on deposit in the herbarium of the Missouri Botanical Garden.

I should like to thank Dr. Carroll W. Dodge for his valuable guidance and assistance throughout this study.

## LIST OF SPECIES

*VERRUCARIA FUSCELLA* (Turn.) Ach.—ARIZONA: Tucson, on caliche, 2500 ft., Dec. 4, 1933, *Darrow* 572; Tucson Mts., on volcanic rock, 3000 ft., March 11, 1934, *Darrow* 746. NEW MEXICO: Chaco Canyon, on sandstone, 6200 ft., Jan. 16 & 20, Feb. 28, 1952, *Elmore*.

*STAUROTHELE UMBRINA* (Ach.) Tuck.—NEW MEXICO: Chaco Canyon, on sandstone, 6200 ft., Jan. 20, 1952, *Elmore*.

*DERMATOCARPON POLYPHYLLUM* (Wulf.) Dalla Torre & Sarnth.—ARIZONA: Pima Co., Rincon Mts., on shale, 4500 ft., March 4, 1934, *Darrow* 697.

*DERMATOCARPON RUPICOLA* Zahlbr.—ARIZONA: Tucson Mts., on andesite, 3500 ft., March 15, 1934, *Darrow* 690.

*ENDOCARPON PUSILLUM* Hedw.—ARIZONA: Tucson Mts., on caliche, 3000 ft., March 11, 1934, *Darrow* 745.

*ARTHOPYRENIA HALODYTES* (Nyl.) Arn.—NEW MEXICO: Chaco Canyon, on sandstone, 6200 ft., Jan. 16, 1952, *Elmore*.

*PYRENULA NITIDA* (Weig.) Ach.—NEW MEXICO: Chaco Canyon, on greasewood (*Sarcobatus vermiculatus* (Hook.) Torr.), 6200 ft., Jan. 20, 1952, *Elmore*.

*URCEOLARIA SCRUPOSA* (Schreb.) Ach. var. *BRYOPHILA* (Ehrh.) Ach.—ARIZONA: Whitehouse Canyon, Santa Rita Mts., on *Cladonia* primary thalli, Dec. 24, 1933, *Darrow* 537.

*LEPTOGIUM APALACHENSE* Nyl.—ARIZONA: Pima Co., Rincon Mts., on shale, 4500 ft., March 4, 1934, *Darrow* 698.

*LEPTOGIUM BURGESSII* (L.) Mont.—ARIZONA: Whitehouse Canyon, Santa Rita Mts., on soil, Dec. 24, 1933, *Darrow* 533.

*PLACYNTHIUM MICROPHYLLIZUM* (Nyl.) Hasse—ARIZONA: Tucson, on soil, 2500 ft., Nov. 26, 1933, Apr. 5, 1934, *Darrow* 527, 691; Pima Co., Cortaro, on soil, 3000 ft., Nov. 26, 1933, *Darrow* 528; Pima Co., Rincon Mts., on soil, 3500 ft., March 4, 1934, *Darrow* 740, 741.

*LECIDEA BRANDEGEI* Tuck.—NEW MEXICO: Chaco Canyon, on sandstone, 6200 ft., Jan. 16, 1952, *Elmore*.

*LECIDEA PARASEMA* Ach.—NEW MEXICO: Chaco Canyon, on sandstone, 6200 ft., Jan. 16, 1952, *Elmore*.

*LECIDEA PLANA* (Lahm) Nyl.—NEW MEXICO: Chaco Canyon, on sandstone, 6200 ft., Feb. 28, 1952, *Elmore*.

*LECIDEA VORTICOSA* (Floerke) Koerb.—NEW MEXICO: Chaco Canyon, on sandstone, 6200 ft., Feb. 28, 1952, *Elmore*.

RHIZOCARPON DISPORUM (Naeg.) Müll. Arg.—ARIZONA: Mt. Lemmon, Santa Catalina Mts., on marble, 8500 ft., April 1, 1934, *Darrow 721*.

ACAROSPORA AMERICANA H. Magn.—ARIZONA: Tucson Mts., on volcanic rock, March 11, 1934, *Darrow 747*; NEW MEXICO: Chaco Canyon, on sandstone, 6200 ft., Feb. 28, 1952, *Elmore*.

ACAROSPORA COLORADINA H. Magn.—ARIZONA: Tucson Mts., on volcanic rock, 3000 ft., March 11, 1934, *Darrow 746*.

ACAROSPORA OXYTONA (Ach.) Mass.—NEW MEXICO: Chaco Canyon, on sandstone, 6200 ft., Jan. 20, 1952, *Elmore*.

ACAROSPORA PELTASTICA Zahlbr.—ARIZONA: Tucson Mts., on volcanic rock, 3000 ft., March 11, 1934, *Darrow 736*; NEW MEXICO: Chaco Canyon, on sandstone, 6200 ft., Jan. 20, 1952, *Elmore*.

ACAROSPORA STRIGATA (Nyl.) Jatta—NEW MEXICO: Chaco Canyon, on sandstone, 6200 ft., Jan. 16 & 20, 1952, *Elmore*.

ACAROSPORA TENEBRICA H. Magn.—NEW MEXICO: Chaco Canyon, on sandstone, 6200 ft., Feb. 28, 1952, *Elmore*.

ACAROSPORA WASHINGTONENSIS H. Magn.—ARIZONA: Pima Co., Rincon Mts., on schist, 4500 ft., March 4, 1934, *Darrow 788*.

PERTUSARIA FLAVICUNDA Tuck.—ARIZONA: Santa Rita Mts., on igneous rock, 7200 ft., Aug. 14, 1934, *Darrow 820*.

LECANORA ATRA (Huds.) Ach.—ARIZONA: Patagonia Mts., on granite, 5500 ft., Oct. 6, 1946, *Darrow 4252*.

LECANORA CENISIA Ach.—ARIZONA: Santa Rita Mts., on igneous rock, 7000 ft., July 16, 1934, *Darrow 796*.

LECANORA CONTORTA (Hoffm.) Stiz.—ARIZONA: Mt. Lemmon, Santa Catalina Mts., on quartz, 8500 ft., April 1, 1934, *Darrow 724*.

LECANORA DIFFRACTA Ach.—ARIZONA: Whitehouse Canyon, Santa Rita Mts., on granite, 6500 ft., Dec. 24, 1933, *Darrow 470*.

LECANORA (ASPICILIA) *elmorei* E. Rud., var. nov.—TYPE: NEW MEXICO: Chaco Canyon, on sandstone, 6200 ft., Jan. 20, 1952, *T. & F. Elmore*.

Thallus determinatus, laevigatus, obscure olivaceus, areolatus, areolis crassis convexisque, 1–2 mm. diametro; cortex 31–41  $\mu$  crassitudine, K—, fastigiatus, dimidia parte corticis crassitudine strato gelifacto tectus, hyphis circa 3  $\mu$  diametro; algae ad *Trebouxiam* pertinentes, cellulis ad 38  $\mu$  diametro, in strato non continuo, 100–170  $\mu$  crassitudine sub cortice; medulla hyphis laxo contextis circa 4  $\mu$  diametro. Apothecia in areolis crassioribus immersa, unum vel plura in quavis areola, amphithecio prominente, persistente, crasso, thallo concolore, disco concavo obscure olivaceo-alutaceo pulverulento; hypothecium indistinctum sed densum; thecium 150–171  $\mu$  altitudine; paraphyses simplices, septatae, circa 2  $\mu$  diametro, apicibus clavatis; asci 71.5–100.0  $\times$  14.3–15.7  $\mu$ , clavati, apicibus incrassatis; spores uniseriate, 3–4-nae, sphaericae, 17.4–24.4  $\mu$  diametro, granulosae, episporis tenuibus.

Thallus determinate, smooth, deep olive, closely areolate, the areolae thick and convex, 1–2 mm. in diameter; cortex fastigiata, 31–41  $\mu$  thick, covered by a

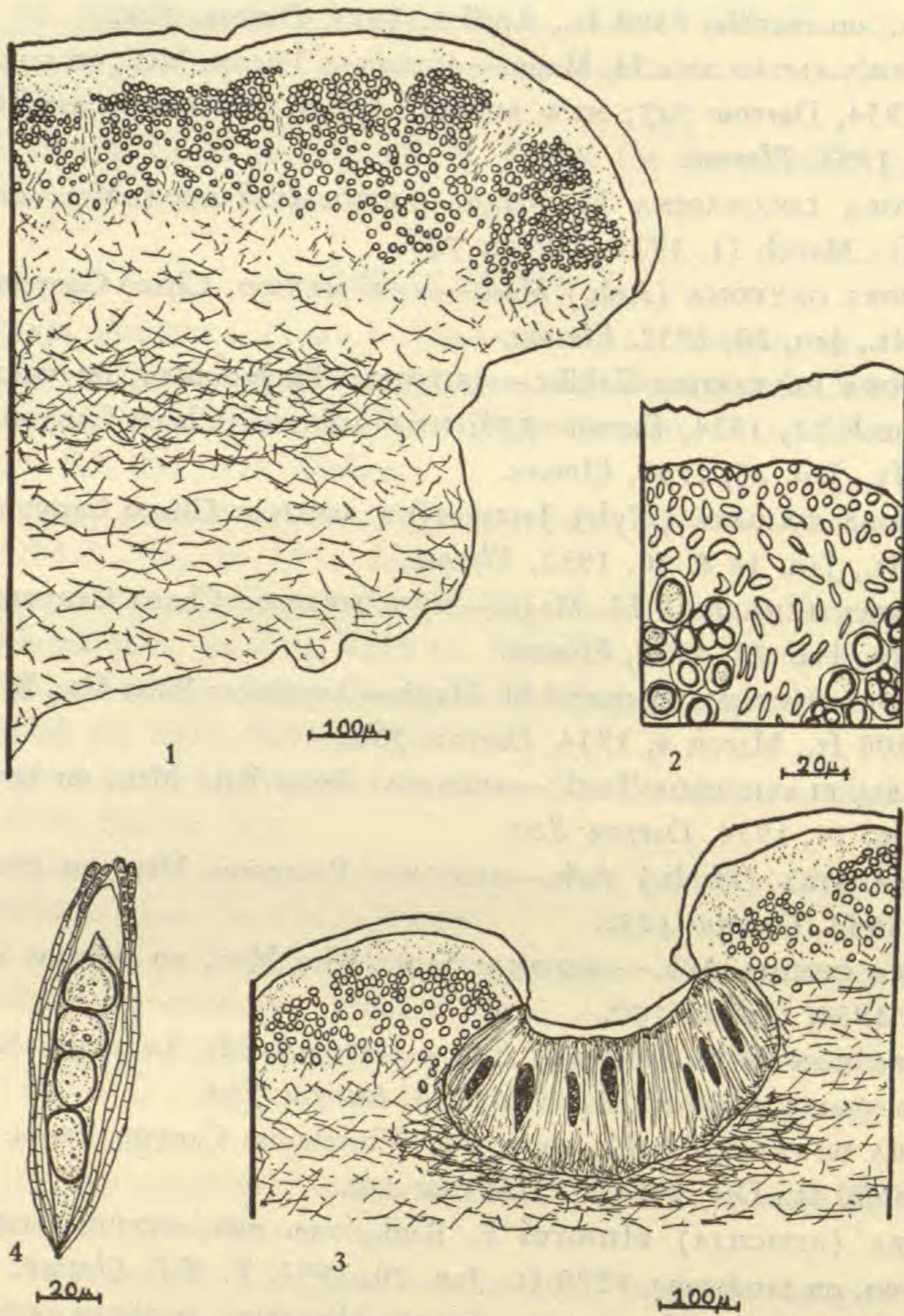


Fig. 1. *Lecanora elmorei* E. Rud.

1. Section of thallus.
2. Enlarged section showing cortex.
3. Section of an apothecium.
4. Ascus with associated paraphyses.

gelatinous layer about half the thickness of the cortex, KOH—, the hyphae approximately  $3\ \mu$  thick; algae *Trebouxia*, forming a layer 100–170  $\mu$  thick below the cortex, broken into vertically rectangular patches separated by fungous hyphae, the cells globular to slightly angular, 10–38  $\mu$  in diameter; medulla of loosely woven hyphae about 4  $\mu$  in diameter. Apothecia sunken, the margin formed of the remaining part of the aerolae, one to several per areolae, the disc very concave, dark olive-buff, appearing powdery; margin persistent, raised and thick, thalline, colored like the thallus; epithecium of gelatinous tips of paraphyses; hypothecium indistinct, slightly denser than the underlying tissues; thecium 150–171  $\mu$  thick, the paraphyses simple, filiform, septate, about 2  $\mu$  thick, the tips swollen. Asci clavate,  $71.5\text{--}100.0 \times 14.3\text{--}15.7\ \mu$  wide, hyaline tips present in many; spores uniseriate, 3–4 per ascus, globose, 17.4–24.4  $\mu$  in diameter, mostly coarsely granular, the episporia thin.

This new species is easily distinguished by its 3–4 globose spores per ascus and by having *Trebouxia* as its alga. The globose-spored species *Lecanora praecrenata* Nyl., with its diffuse, whitish, indeterminate thallus and sessile brown apothecia, contrasts easily with the thick, closely areolate, deep-olive thallus and sunken apothecia of the present species.

LECANORA EPULOTICA (Ach.) Leighton—ARIZONA: Santa Rita Mts., on igneous rock, 6500 ft., July 1, 1934, *Darrow 814*.

LECANORA FRUSTULOSA (Dicks.) Ach.—ARIZONA: Carr Canyon, Huachuca Mts., on marble, 5600 ft., June 12, 1945, *Darrow 4236*.

LECANORA MELAENA (Hedlung) Fink—ARIZONA: Tucson Mts., on calcareous rock, March 25, 1934, *Darrow 682*.

LECANORA PARISENSIS Nyl.—NEW MEXICO: Chaco Canyon, on greasewood (*Sarcobatus vermiculatus* (Hook.) Torr.), 6200 ft., Feb. 28, 1952, *Elmore*.

LECANORA POLYTROPA (Ehrh.) Rabh.—ARIZONA: Santa Rita Mts., Pima Co., on igneous rock, 4500 ft., Aug. 14, 1934, *Darrow 819*.

LECANORA THAMNOPLACA Tuck.—ARIZONA: Santa Rita Mts., on igneous rock, 7000 ft., Aug. 14, 1934, *Darrow 822*; NEW MEXICO: Chaco Canyon, on sandstone, 6200 ft., Jan. 16, 1952, *Elmore*.

PARMELIA NOVO-MEXICANA Gyeln.—NEW MEXICO: Chaco Canyon, on sandstone, 6200 ft., Feb. 28, 1952, *Elmore*.

CALOPLACA arizonica E. Rud. sp. nov.—TYPE: ARIZONA: Cortaro, on rhyolite, 3000 ft., Nov. 26, 1933, *R. A. Darrow 521*.

Thallus areolatus, fuscus; areolae 0.5–1.0 mm., dispersae; cortex circa 18  $\mu$ , fastigiatus, strato gelifacto tectus, K obscure purpurascens; algae protococcoideae ad 10  $\mu$  diametro, cellulis sphaericis vel subangulosis, in strato 90–130  $\mu$  crassitudine sub cortice; medulla hyphis laxae intertextis crystallis saxi impleta. Apothecia 0.2–0.6 mm. diametro, orbiculata, disco ferrugineo-aurantiaco, amphithecio distincto, persistente, tenui, thallo concolore; epithecium crystallis brunneo-luteis inspersum; hypothecium hyalinum, centro circa 70  $\mu$  altitudine; thecium 63–87  $\mu$  altitudine; paraphyses filiformes, 1.7  $\mu$  diametro, simplices, septatae; asci  $24\text{--}42 \times 7\text{--}11\ \mu$ ,

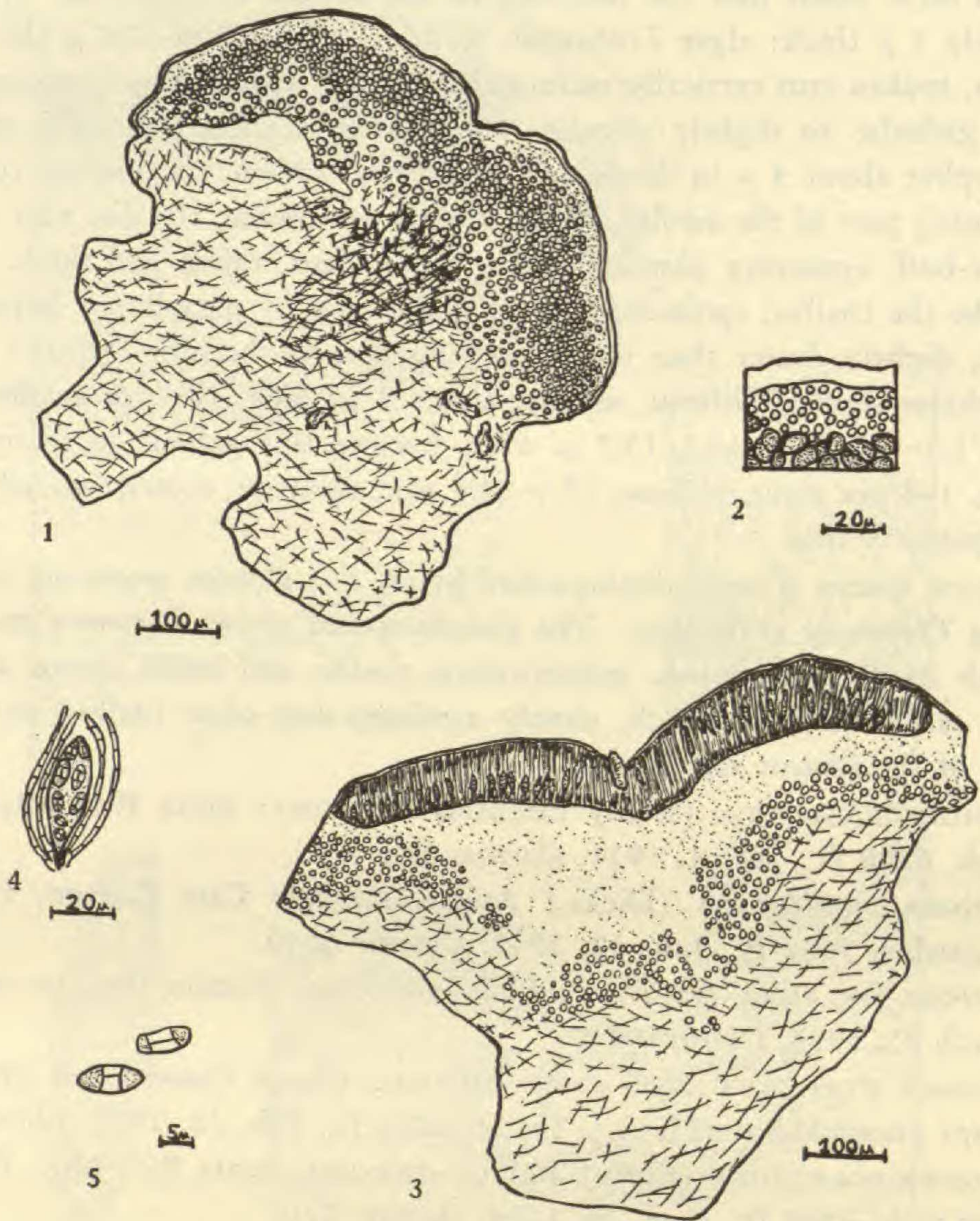


Fig. 2. *Caloplaca arizonica* E. Rud.

1. Section of thallus.
2. Enlarged section showing cortex.
3. Section of an apothecium.
4. Ascus with associated paraphyses.
5. Ascospores.

clavati; sporae 8-nae,  $8.7-12.2 \times 3.5-5.2 \mu$ , polari-biloculares, isthmo circa  $3 \mu$  longitudine, uni- vel biseriales.

Thallus indeterminate, aerolate, fuscous, the areolae 0.5–1.0 mm., often quite far apart; cortex about  $18 \mu$  thick, with a gelatinous covering, fastigate, KOH dark purple; algae protococcoid, forming a layer 90–130  $\mu$  thick below the cortex, the cells round to angular, 5–10  $\mu$  in diameter; medulla of loosely woven hyphae about  $3 \mu$  thick, containing numerous small rock crystals. Apothecia circular, 0.2–0.6 mm., disc brownish-orange, the margin persistent, thin, of the same color as the thallus; algae in the margin and in a layer below the hypothecium; epithecium incrustated with brownish-yellow crystals, about  $13 \mu$  thick; hypothecium hyaline, about  $70 \mu$  thick at center; thecium 63–87  $\mu$  high; paraphyses filiform, septate, about  $1.7 \mu$  thick, unbranched. Asci clavate,  $24-42 \times 7-11 \mu$ ; spores 8, uni- or biserial, polar-bilocular,  $8.7-12.2 \times 3.5-5.2 \mu$ , the isthmus about  $3 \mu$  long.

This species somewhat resembles *Caloplaca cinnabarina* (Ach.) Zahlbr., but can be distinguished by its relatively fewer and more dispersed apothecia, darker thallus, and narrower spores.

*CALOPLACA CERINA* (Ehrh.) T. Fries—NEW MEXICO: Chaco Canyon, on sandstone, 6200 ft., Jan. 16, 1952, *Elmore*.

*CALOPLACA CINNABARINA* (Ach.) Zahlbr.—ARIZONA: Whitehouse Canyon, Santa Rita Mts., on granite, 6500 ft., Dec. 24, 1933, *Darrow 471*.

*CALOPLACA ELEGANS* (Link) T. Fries—NEW MEXICO: Chaco Canyon, on sandstone, 6200 ft., Jan. 16 & 20, Feb. 28, 1952, *Elmore*.

*CALOPLACA FESTIVA* (Ach.) Zwackh.—ARIZONA: Miller Canyon, Huachuca Mts., on igneous rock, 6300 ft., June 14, 1945, *Darrow 4243*.

*CALOPLACA FULGENS* (Swartz) Koerb.—ARIZONA: Nogales, on calcareous rock, 4000 ft., Oct. 6, 1946, *Darrow 4261*; NEW MEXICO: Chaco Canyon, on sandstone, 6200 ft., Feb. 28, 1952, *Elmore*.

*CALOPLACA LOBULATA* (Floerke) Hellb.—ARIZONA: Pima Co., Rincon Mts., on granite, 4000 ft., March 4, 1934, *Darrow 785*.

*CALOPLACA MODESTA* (Zahlbr.) Fink—ARIZONA: Tucson Mts., on calcareous rock, 3000 ft., March 19, 1934, *Darrow 730*; Pima Co., Coyote Mts., on granite, 3200 ft., Feb. 16, 1945, *Darrow 4266*.

*TELOSCHISTES PARIETINUS* (L.) Norm.—NEW MEXICO: Chaco Canyon, on sandstone, 6200 ft., Jan. 16, 1952, *Elmore*.

*BUELLIA BLUMERI* Zahlbr.—ARIZONA: Whitehouse Canyon, Santa Rita Mts., on igneous rock, 6500 ft., Dec. 24, 1933, *Darrow 477*.

*BUELLIA RETROVERTENS* Tuck.—ARIZONA: Whitehouse Canyon, Santa Rita Mts., on granite, 6500 ft., Dec. 24, 1933, *Darrow 489*; Tucson Mts., on volcanic rock, 3000 ft., March 19, 1934, *Darrow 736*; NEW MEXICO: Chaco Canyon, on sandstone, 6200 ft., Feb. 28, 1952, *Elmore*.

*RINODINA darrovii* E. Rud. sp. nov.—TYPE: ARIZONA: Santa Catalina Mts., on ground and moss, Nov. 12, 1933, *R. A. Darrow 498*; PARATYPE: Santa Catalina Mts., on soil, 8000 ft., Nov. 12, 1933, *Darrow 503*.

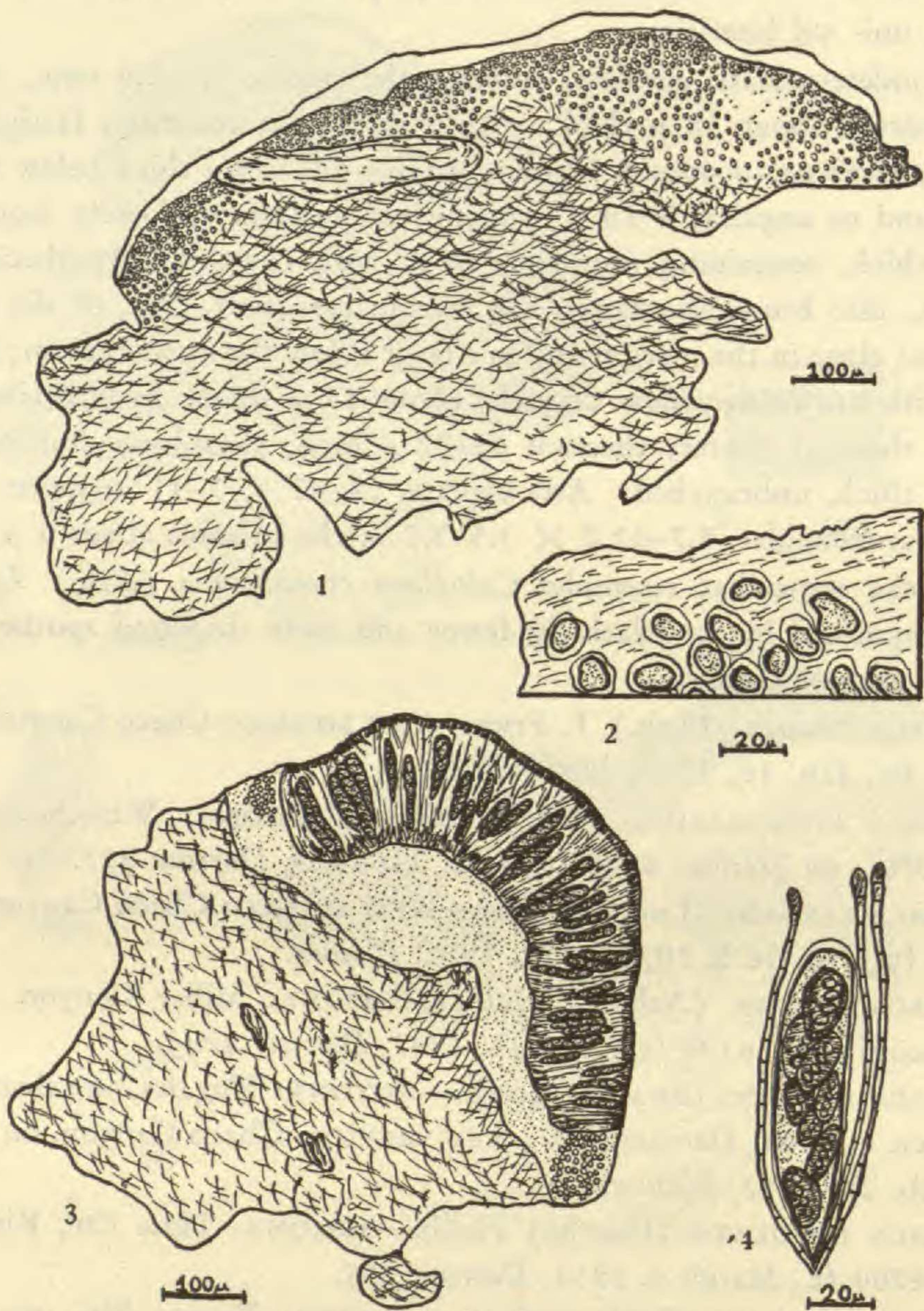


Fig. 3. *Rinodina darrovii* E. Rud.

1. Section of thallus.
2. Enlarged section showing cortex.
3. Section of an apothecium.
4. Ascus with associated paraphyses.



Thallus ochraceus vel cinnabarinus, granulosus, K—, diffractus; cortex gelifactus, erodus; algae protococcoideae, cellulis sphaericis vel angulosis, 5–10  $\mu$  diametro, in strato continuo 57–71  $\mu$  crassitudine sub cortice; medulla densa, hyphis indistinctis circa 1.5  $\mu$  diametro intertextis. Apothecia nigra, 0.5–1.0 mm. diametro, plana vel convexa; margine thalloideo, tenui, mox emarginato, thallo concolore; hypothecium hyalinum, in centro 80  $\mu$  altitudine; thecium 27–34  $\mu$  altitudine; paraphyses 2  $\mu$  diametro, septatae, simplices; asci 70–71  $\times$  10–16  $\mu$ , clavati; spores 8-nae, biseriatae, 17.4–24.4  $\times$  8.7–11.5  $\mu$ , primo non-septatae, deinde tri-septatae, brunneae.

Thallus ochraceous-tawny to cinnamon-brown, granulose, broken in places into irregular pieces, KOH—; cortex gelatinous, eroded in parts; algae protococcoid, forming a continuous layer 57–71  $\mu$  thick, the cells spherical to angular, 5–10  $\mu$  in diameter; medulla of tightly woven, indistinct hyphae about 1.5  $\mu$  in diameter. Apothecia black, 0.5–1.0 mm. in diameter; disc flat to convex; margin thalloid, thin, of same color as the thallus, soon disappearing; hypothecium hyaline, of closely woven hyphae, about 80  $\mu$  thick at center; thecium 27–34  $\mu$  high; paraphyses filiform, septate, about 2  $\mu$  thick, swollen at tips and incrustated with yellow crystals, unbranched; asci clavate, 70–71  $\times$  10–16  $\mu$ ; spores 8, biseriate, brown, at first 1-celled becoming 4-celled, 17.4–24.4  $\times$  8.7–11.5  $\mu$ .

This species has the general appearance of *Rinodina phaeocarpha* (Sommerf.) Vainio (*R. nimbosea* (E. Fr.) T. Fr.) but the four-celled spore places it in the subsection CONRADIA Malme as recognized by Zahlbruckner (1926). Its affinities seem to be with *R. conradi* Koerb. from which it can be separated by its larger black apothecia, its indistinct cortical hyphae, and its thicker hypothecium. The spores in this species have not been found to have more than four cells and also to be slightly smaller than those of *R. conradi*.

RINODINA EURYSPORA Zahlbr.—ARIZONA: Santa Rita Mts., on igneous rock, 7000 ft., Aug. 14, 1934, *Darrow 821*.

RINODINA NOVOMEXICANA B. de Lesd.—ARIZONA: Santa Rita Mts., on igneous rock, 4500 ft., June 3, 1934, *Darrow 707*; 7000 ft., Aug. 14, 1934, *Darrow 823*.

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